IN THE UNITED STATES PATENT AND TADEMARK OFFICE

Applicant: Jorge A. Morando

Serial No.: 09/005,497 Examiner: Scott Kastler

Filed: January 12, 1998 Art Unit: 1742

For: JET COLUMN REACTOR PUMP WITH COAXIAL AND/OR LATERAL INTAKE OPENINGS

Declaration of Jorge A. Morando

I, Jorge A. Morando, declare:

1. I am the inventor of the above-captioned patent application.

2. I have read and understand the application and the Office Actions of February 8, 1999 and June 2, 1999.

3. I am familiar with the "admitted prior art" of the Disclosure.

4. I am familiar with the operation of reactor pumps of the admitted prior art. I have conducted tests of the inventive reactor pump as follows:

Under the auspices of Metaullics Systems Co., L.P., Solon, Ohio, and under the supervision of Mr. Mark Bright, Engineering Manager, Advanced Products Development, three gas pumps were tested, namely: a) Bubble Pump, b) Jet Reacting-Coaxial Pump, and c) Peripheral Jet Pump, illustrate my invention. (See attached Figure 1, Figure 2 and Figure 3.) All three pumps had the same submergence (20.5 inches), the same piping diameters and nozzle areas. The pumps were tested in water at room temperature. The results of the tests are shown in Figure 4. The conclusions are as follows:

(1) The Peripheral Jet Pump had a performance nearly 90% higher flow over the Bubble Pump, due to the additional energy momentum obtained from the supplied gas and the increase of fluid velocity.

(2) The flow velocity was nearly twice that of the Bubble Pump.

(3) The gas recovery system recovered 99.0% of the nitrogen supplied.

(4) The Coaxial inlet design added to the sonic jet, allowed pumping to be performed at depths as low as 1.50 inches from the liquid surface to the center line of the pump pipe.

(5) The Coaxial gas inlet jet pump also performed better than the Bubble Pump, pumping 20% higher flows at equal gas flows. The performance was not higher because of the obstruction the gas inlet pipe creates in the inlet pipe, also because the single nozzle jet allowed coalescence of the bubbles much sooner (shorter jet) than the Peripheral design (three nozzles).

(6) The bubble pump formed large bubbles almost immediately, saturating the pipe with gas and preventing flow increases. Increasing the gas inlet pressure past the saturation point only reduced liquid flow as theoretically predicted.

From the degassing point of view, the results were even more dramatic (See Figure 5).

The water tank was saturated with oxygen and then the pump tested while measuring the oxygen desorption efficiency. Oxygen desorption is the oxygen removed by the N_2 action created by the pump's: a) velocity, b) flow, c) quantity and bubbles' diameter (desorption is inversely proportional to the bubble diameter), and d) time of residence of the N_2 bubbles in the liquid. Because of the strong jets created by both the Coaxial design and the Peripheral design, both outperformed the Bubble Pump degassing performance by over 500% (See Figure 5), despite the fact that the Peripheral Pump was only 1.5 inches in diameter instead of 3.0 inches.

The chart on the following pages is a comparison of the different gas pumps showing that the Coaxial gas inlet and the Peripheral gas inlet designs basically do not have, either mechanically or thermodynamically, any relation to the Bubble Pump, since they operate on different physical, thermodynamic and design principles.

Figure 6 is a drawing of the Peripheral Pump gas injector ring configuration.

5. My Peripheral gas jet pump <u>does not</u> require an inclined conduit, as does a bubble type. My gas jet pump does not require the gas jet to be delivered at the lower part of the metal moving conduit. See for example the embodiments of Figures 12 (gas delivered horizontally), and Figure 19, (gas delivered downwardly from the upper part of the conduit). Figures 12 and 19 refer to the specification drawings.

My Peripheral jet reactor pump does not rely solely on the creation of bubbles in moving the metal. The high-pressure gas jet defined in the pending claims can move the metal upwardly, horizontally or even downwadly. This is because the momentum of the gas jet is relied upon for moving the metal.

Areaux does not teach of either introducing a gas jet into the metal conveying conduit, or introducing the gas jet in the direction of the metal moving passage along the axis of motion of the metal. Areaux does not teach of using gas jet momentum, only gas bubbles for moving the metal. See for example Areaux's Figures 2, 3, 5, 7, 10 and 18 which clearly show the gas introduced at right angles to the metal flow. Figures 13 and 14 suggest introducing gas in a direction opposite to the metal flow. Areaux relies solely on the bubble phenomena for raising the gas. If you rely solely on bubbles, it makes no difference what direction the gas is introduced in the metal-moving conduit. The gas must be introduced into the lower part of the conduit so the bubbles can rise.

In fact, if used as taught by Areaux's disclosure, a gas jet will tend to form a blockage at the point it is introduced. If the gas is introduced as a gas jet at right angles or downstream of the metal flow, it will tend to push the metal toward the inlet end of the conduit.

When employed for raising the metal, a gas jet gradually coalesces to form bubbles so that the bubble phenomenon cooperates with the gas momentum to move the molten metal. The transfer to the metal of the gas momentum provides the energy for moving the metal.

The pending claims, which refer to the convergent/divergent configuration in the metal-moving conduit, describe a structure that causes the gas jet to be forcibly diffused into the metal. The gas then coalesces in a series of bubbles because of the deceleration of the gas and the surface tension. These structural limitations are not suggested by Areaux.

The undersigned declares further that all statements made on information and belief are believed to be true; and willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issuing therein.

Jorge A. Morando

Date: August 23, 1999